

CLAIMS

1. A method of stabilizing a waste in chemically bonded phosphate ceramic comprising:
preparing a slurry comprising the waste, water, an oxide binder and a phosphate
binder;
5 allowing the slurry to cure to a solid hydrated chemically bonded phosphate ceramic
matrix; and
removing bound water from the solid hydrated chemically bonded phosphate ceramic
matrix.
- 10 2. The method of claim 1 wherein the bound water is removed from the hydrated
ceramic matrix by heating.
3. The method of claim 2 wherein the hydrated ceramic matrix is heated to a select
temperature between a lower first temperature where the bound water begins to be driven
15 from the hydrated ceramic matrix and a higher second temperature where non-water
components of the hydrated ceramic matrix are volatilized.
4. The method of claim 3 wherein the select temperature is between 100 °C and 200 °C.
- 20 5. The method of claim 1 wherein the waste and the water have been mixed prior to the
preparation of the slurry and further comprising removing a select amount of water from the
waste and water mixture prior to preparation of the slurry.
6. The method of claim 5 wherein the select amount of water is removed from the waste
25 and water mixture through evaporation by heating.

7. The method of claim 5 wherein the quantity of water removed from the waste and water combination is selected to result in a solids content within the waste and water combination, after the removal step, of equal to or less than 90% measured by weight.

5 8. The method of claim 1 further comprising removing water from the slurry while allowing the slurry to cure.

9. The method of claim 8 wherein the water is removed from the slurry through evaporation by heating, and wherein the slurry is heated to a select curing temperature
10 between a first curing temperature where water is removed from the slurry as it cures and a second curing temperature where non-water components of the slurry are volatilized.

10. The method of claim 9 wherein the select curing temperature is between 100 °C and 200 °C.

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11. The method of claim 1 wherein the oxide binder is a divalent metal oxide and the phosphate binder is KH_2PO_4 .

12. The method of claim 11 wherein the oxide binder is MgO .

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13. The method of claim 1 further comprising adding a select amount of one of a reducing agent and an oxidizing agent to the slurry prior to allowing the slurry to cure.

14. The method of claim 1 further comprising adding H_3PO_4 to the slurry to reduce the
25 slurry pH.

15. The method of claim 1 further comprising adding a metal oxide to the slurry to increase the slurry pH.

16. A method of stabilizing a waste in chemically bonded phosphate ceramic comprising:
providing a mixture of the waste and water;
removing a select amount of water from the waste and water mixture to form a
residual waste and water mixture;
5 preparing a slurry comprising the residual waste and water mixture, an oxide binder
and a phosphate binder; and
allowing the slurry to cure to a solid chemically bonded phosphate ceramic matrix.

17. The method of claim 16 wherein the select amount of water is removed from the
10 waste and water mixture through evaporation by heating.

18. The method of claim 16 wherein the quantity of water removed from the waste and
water mixture is selected to result in a solids content within the waste and water mixture,
after the removal step, of equal to or less than 90% measured by weight.
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19. The method of claim 16 further comprising removing water from the slurry while
allowing the slurry to cure.

20. The method of claim 19 wherein the water is removed from the slurry through
20 evaporation by heating, and wherein the slurry is heated to a select curing temperature
between a first curing temperature where water is removed from the slurry as it cures and a
second temperature where non-water components of the slurry are volatilized.

21. The method of claim 20 wherein the select curing temperature is between 100 °C and
25 200 °C.

22. The method of claim 16 wherein the oxide binder is a divalent metal oxide and the phosphate binder is KH_2PO_4 .

5 23. The method of claim 22 wherein the oxide binder is MgO .

24. The method of claim 16 further comprising adding a select amount of one of a reducing agent and an oxidizing agent to the slurry prior to allowing the slurry to cure.

10 25. The method of claim 16 further comprising adding H_3PO_4 to the slurry to reduce the slurry pH.

26. The method of claim 16 further comprising adding a metal oxide to the slurry to increase the slurry pH.

27. A method of stabilizing a waste in a chemically bonded phosphate ceramic comprising:

preparing a slurry comprising the waste, water, an oxide binder and a phosphate binder; and

5 removing water from the slurry while allowing the slurry to cure.

28. The method of claim 27 wherein the water is removed from the slurry through evaporation by heating, and wherein the slurry is heated to a select curing temperature between a first curing temperature where water is removed from the slurry as it cures and a
10 second curing temperature where non-water components of the slurry are volatilized.

29. The method of claim 28 wherein the select curing temperature is between 100 °C and 200 °C.

15 30. The method of claim 27 wherein the oxide binder is a divalent metal oxide and the phosphate binder is KH_2PO_4 .

31. The method of claim 30 wherein the oxide binder is MgO .

20 32. The method of claim 27 further comprising adding a select amount of one of a reducing agent and an oxidizing agent to the slurry prior to allowing the slurry to cure.

33. The method of claim 27 further comprising adding H_3PO_4 to the slurry to reduce the slurry pH.

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34. The method of claim 27 further comprising adding a metal oxide to the slurry to increase the slurry pH.

35. A ceramic waste form produced from the method recited in claim 1.

36. A ceramic waste form produced from the method recited in claim 16.

5 37. A ceramic waste form produced from the method recited in claim 27.